

Enumeration is the process where the PC's operating system gathers information from a USB device that describes it and its capabilities. The low-level drivers for the LabJack U12 come with Windows and enumeration will proceed automatically. The first time a device is enumerated on a particular PC, it can take a minute or two, and Windows might prompt you about installing drivers. Accept all the defaults at the Windows prompts, and reboot the PC if asked to do so. The Windows Installation CD might also be needed at this point. Make sure a CD with the correct version of Windows is provided. Enumeration occurs whenever the USB cable is connected, and only takes a few seconds after the first time.

When enumeration is complete, the LED will blink twice and remain on. This means Windows has enumerated the LabJack properly.

If the LabJack fails to enumerate:

- Make sure you are running Windows OS version 4.10.2222 or higher,
- If Win98SE, check out win98sehid.zip from our downloads page,
- Try connecting the LabJack to another PC,
- Try connecting a different USB device to the PC,
- Check our online forum and/or contact LabJack.

Software Installation

Although, the low-level USB drivers for the LabJack are included with Windows, high-level drivers are needed to send and receive data. The included LabJack CD installs the high-level drivers, example source code, and example applications.

Close all open applications, especially LabJack related software, and insert the LabJack CD. If autorun is enabled, the installation program should start automatically. If the installation does not start, you will have to manually double-click on LabJackVXXX.exe.

When the LabJack installation is finished, it will start the National Instruments LabVIEW Run-Time Engine (LVRTE) setup. The LVRTE is required for the example applications, such as LJtest. If prompted to reboot after this installation, go ahead and do so. Virus scanners can often interfere with the installation of the LVRTE. If you have trouble running the example applications, repeat the LabJack software installation to make sure the LVRTE is installed.

To test the installation, start LJtest by selecting

Start => Programs => LabJack => LJtest.

Make sure "Test Fixture Installed" and "Continuous" are not selected, and press the "Run" button. LJtest should step through and pass 8 separate tests.

Hardware Description

The external features of the LabJack U12 are:

- USB connector
- DB25 digital I/O connector (D lines)
- Status LED
- 30 screw terminals.

The USB connection provides power and communication. No external power supply is needed. The +5 volt connections available at various locations are outputs, do not connect a power supply.



Figure 1. LabJack U12 top surface.

Figure 1 shows the top surface of the LabJack U12. Not shown are the USB and DB25 connectors, which are both on the top edge. The DB25 connector provides connections for 16 digital I/O lines, called D0-D15. It also has connections for ground and +5 volts. All connections besides D0-D15, are provided by the 30 screw terminals shown in Figure 1. Each individual screw terminal has a label, AI0 through STB.

- **AI0 – AI7:** The LabJack U12 has 8 screw terminals for analog input signals. These can be configured individually and on-the-fly as 8 single-ended channels, 4 differential channels, or combinations in between. Each input has a 12-bit resolution and an input bias current of $\pm 90 \mu\text{A}$.
 - Single-Ended: The input range for a single ended measurement is ± 10 volts.
 - Differential channels can make use of the PGA to provide gains up to 20, giving an effective resolution greater than 16-bits. In differential mode, the voltage of each AI with respect to ground must be between ± 10 volts, but the range of voltage difference between the 2 AI is a function of gain (G) as follows:

G=1	± 20 volts
G=2	± 10 volts
G=4	± 5 volts
G=5	± 4 volts
G=8	± 2.5 volts
G=10	± 2 volts
G=16	± 1.25 volts
G=20	± 1 volt

- **AO0 & AO1:** The LabJack U12 has 2 screw terminals for analog output voltages. Each analog output can be set to a voltage between 0 and the supply voltage (+5 volts nominal) with 10-bits of resolution.
- **IO0 – IO3:** Connections to 4 of the LabJack's 20 digital I/O are made at the screw terminals, and are referred to as IO0-IO3. These 4 channels include a $1.5 \text{ k}\Omega$ series resistor that provides overvoltage/short-circuit protection.
- **D0 – D15:** Connections to 16 of the LabJack's 20 digital I/O are made at the DB25 connector, and are referred to as D0-D15. These 16 lines have no overvoltage/short-circuit protection, and

can sink or source up to 25 mA each (total sink or source current of 200 mA max for all 16). All digital I/O are CMOS output and TTL input except for D13-D15, which are Schmitt trigger input.

DB25 Pinouts:

1: D0	6: D5	11: +5V	16: GND	21: D11
2: D1	7: D6	12: +5V	17: GND	22: D12
3: D2	8: D7	13: +5V	18: D8	23: D13
4: D3	9: NC	14: GND	19: D9	24: D14
5: D4	10: +5V	15: GND	20: D10	25: D15

- **CNT:** The input connection to the 32-bit counter is made at screw-terminal CNT. The counter is incremented when it detects a falling edge followed by a rising edge, and is capable of counting frequencies up to at least 1 MHz.
- **CAL & STB:** These terminals are used during testing and calibration. The CAL terminal is a 2.5 volt reference.
- **+5V:** The LabJack has a nominal +5 volt internal power supply. Power can be drawn from this power supply by connecting to the +5V screw-terminals, or the +5V pins on the DB25 connector. The total amount of current that can be drawn from the +5V pins, analog outputs, and digital outputs, is 450 mA for most desktop computers and self-powered USB hubs. Some notebook computers and bus-powered hubs will limit this available current to about 50 mA.
- **GND:** The GND connections available at the screw-terminals and DB25 connector provide a common ground for all LabJack functions.

LabJack Operation

The LabJack U12 CD installs 9 example applications: LJconfig, LJcounter, LJfpg, LJlogger, LJscope, LJstream, LJtest, LJSHT, and LJSHTmulti. The LabVIEW source code for most of these is installed in the examples directory.

Also installed are high-level drivers (ljackuw.dll), an ActiveX interface to the high-level drivers (ljackuw.ocx), and LabVIEW VIs which call all the DLL functions. The DLL and OCX are installed in the Windows System directory. If the installation program can determine the LabVIEW directory, it copies the LabVIEW drivers into that directory (\vi.lib\addons\l) so they show up on the function palette. Otherwise, the LabVIEW drivers are copied into the LabJack installation directory (c:\Program Files\LabJack\drivers\labview), and can manually be transferred to the LabVIEW directory.

Example Applications

- **LJconfig:** Sets the local ID of a particular LabJack. This is useful if multiple LabJacks are connected to the USB. Every LabJack has a local ID and serial number. The local ID is a value between 0 and 255 that can be changed by the user. The serial number is a value between 256 and 2,147,483,647. The serial number is unique among all LabJacks and cannot be changed by the user.
- **LJcounter:** Reads the LabJack counter and provides the frequency or count.
- **LJfpg:** Outputs basic waveforms on A00 (analog output zero).
- **LJlogger:** Sends and receives data from all channels in command/response mode.
- **LJscope:** Simulates an oscilloscope by reading data from 2 AI channels in burst mode.
- **LJstream:** Uses stream mode to read, graph, and write to file, 4 AI channels.
- **LJtest:** Runs a sequence of tests on the LabJack itself. Users will generally leave "Test Fixture Installed" unselected and execute the tests with nothing connected to the LabJack (except the USB of course).
- **LJSHT:** Retrieves and records data from 1 or 2 EI-1050 digital temperature/humidity probes.
- **LJSHTmulti:** Displays data from up to 20 EI-1050 digital temperature/humidity probes.

Drivers

There are 37 functions exported by the LabJack DLL., and matching functions in the OCX and LabVIEW VIs. All functions are command/response except for AIBurst and

AIStreamStart/Read/Clear. Following is a brief description of each function. For more details on each function see the *LabJack U12 User's Guide*.

- **EAnalogIn:** Reads the voltage from one analog input.
- **EAnalogOut:** Sets the voltage on both analog outputs.
- **ECount:** Reads and resets the counter.
- **EDigitalIn:** Reads the state of one digital input.
- **EDigitalOut:** Sets the state of one digital output.
- **AISSample:** Reads the voltages from 1,2, or 4 analog inputs. Also controls/reads the 4 IO ports.
- **AIIBurst:** Reads a specified number of scans (up to 4096) at a specified scan rate (up to 8192 Hz) from 1,2, or 4 analog inputs. First, data is acquired and stored in the LabJack's 4096 sample RAM buffer. Then, the data is transferred to the PC.
- **AIStreamStart:** Starts a hardware timed continuous acquisition where data is sampled and stored in the LabJack RAM buffer, and can be simultaneously transferred out of the RAM buffer to the PC application. A call to this function should be followed by periodic calls to AIStreamRead, and eventually a call to AIStreamClear.
- **AIStreamRead:** Waits for a specified number of scans to be available and reads them. AIStreamStart should be called before this function and AIStreamClear should be called when finished with the stream.
- **AIStreamClear:** This function stops the continuous acquisition. It should be called once when finished with the stream.
- **AOUpdate:** Sets the voltages of the analog outputs. Also controls/reads all 20 digital I/O and the counter.
- **AsynchConfig:** Configures the LabJack U12 D lines for asynchronous communication.
- **Asynch:** Writes then read half-duplex asynchronous data on 1 of two pairs of D lines. Basically RS232 communication.
- **BitsToVolts:** Converts a 12-bit (0-4095) binary value into a LabJack voltage. $Volts = ((2 * Bits * Vmax / 4096) - Vmax) / Gain$ where $Vmax = 10$ for SE, 20 for Diff.
- **VoltsToBits:** Converts a voltage to its 12-bit (0-4095) binary representation. $Bits = (4096 * ((Volts * Gain) + Vmax)) / (2 * Vmax)$
- **Counter:** Controls and reads the counter. The counter is disabled if the watchdog timer is enabled.
- **DigitalIO:** Reads and writes to all 20 digital I/O.
- **GetDriverVersion:** Returns the version number of ljackuw.dll.
- **GetErrorString:** Converts a LabJack errorcode, returned by another function, into a string describing the error.
- **GetFirmwareVersion:** Retrieves the firmware version from the LabJack.
- **GetWinVersion:** Uses a Windows API function to get the OS version.
- **ListAll:** Searches the USB for all LabJacks, and returns the serial number and local ID for each.
- **LocalID:** Changes the local ID of a specified LabJack. Changes will not take effect until the LabJack is re-enumerated or reset, either manually by disconnecting and reconnecting the USB cable or by calling ReEnum or Reset.
- **NoThread:** Disables thread creation. Use with TestPoint on Windows 98/ME.
- **PulseOut:** Creates pulses on any/all of D0-D7.
- **PulseOutStart:** Starts a pulse output similar to PulseOut, but does not wait for it to finish.
- **PulseOutFinish:** Waits for the finish of a pulse output started with PulseOutStart.
- **PulseOutCalc:** Used to calculate cycle times for the pulse output functions.
- **ReEnum:** Causes the LabJack to electrically detach from and re-attach to the USB so it will re-enumerate. The local ID and calibration constants are updated at this time.
- **Reset or ResetLJ:** Causes the LabJack to reset after about 2 seconds. After resetting the LabJack will re-enumerate.
- **SHT1X:** Retrieves temperature and/or humidity readings from an SHT1X sensor.
- **SHTComm:** Generic low-level function to send and receive up to 4 bytes to/from an SHT1X sensor.
- **SHTCRC:** Checks the CRC on an SHT1X communication.
- **Synch:** Performs SPI communication with a slave device.

- **Watchdog:** Controls the LabJack watchdog function. When activated, the watchdog can change the states of digital I/O if the LabJack does not successfully communicate with the PC within a specified timeout period. This function could be used to reboot the PC allowing for reliable unattended operation. The 32-bit counter (CNT) is disabled when the watchdog is enabled.
- **ReadMem:** Reads 4 bytes from a specified address in the LabJack's nonvolatile memory.
- **WriteMem:** Writes 4 bytes to the LabJack's 8,192 byte nonvolatile memory at a specified address. The data is read back and verified after the write. Memory 0-511 is used for and calibration data. Memory from 512-1023 is unused by the LabJack and available for the user (this corresponds to starting addresses from 512-1020). Memory 1024-8191 is used as a data buffer in hardware timed AI modes (burst and stream).

Warranty

The LabJack U12 comes with a 1 year limited warranty from LabJack Corporation (LC), covering this product and parts against defects in material or workmanship. The LabJack can be damaged by misconnection (such as connecting 120 VAC to any of the screw terminals), and this warranty does not cover damage obviously caused by the customer. If you have a problem, contact support@labjack.com for return authorization. In the case of warranty repairs, the customer is responsible for shipping to LC, and LC will pay for the return shipping.

Declaration of Conformity

Manufacturers Name: LabJack Corporation

Manufacturers Address: 13701 W Jewell Ave, STE 284, Lakewood, CO 80228, USA

Declares that the product

Product Name: LabJack U12

Model Number: LJU12

conforms to the following Product Specifications:

EMC Directive: 89/336/EEC

EN 55011 Class A

EN 61326-1: General Requirements

EN 61000-4-2: 1995

EN 61000-4-3: 1995

and is marked with CE.